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Use of GNSS radio occultation data for climate monitoring and trend detection

William Schreiner[†]; Ying-Hwa Kuo; Shu-Peng Ho; Sergey Sokolovskiy; Doug Hunt
[†] UCAR, USA
Leading author: schrein@ucar.edu

Measurements from low Earth orbiting (LEO) Global Navigation Satellite System (GNSS) radio occultation (RO) receivers are becoming a benchmark dataset of the international global climate observing system. The high vertical resolution, precision, and accuracy of retrieved atmospheric profiles make GPS RO ideal for weather and space weather specification and forecasting, and climate change research and detection. With a GPS receiver on board a low-Earth orbiting (LEO) satellite, the amplitude and phase of the radio frequency (RF) signals transmitted from GPS satellites can be measured very precisely as the ray tangent point descends from ~100 km altitude to the surface when the GPS satellite is occulted by Earth's atmosphere. With proper algorithms and observational modeling, vertical profiles of bending angle are derived that are traceable to the international system of units (SI), i.e., the second. Profiles of refractivity, and subsequently pressure, temperature and humidity can then be derived with additional a priori information. This presentation gives an overview of GNSS RO data processing algorithms and investigates the noise level and consistency of RO bending angle profile data from different RO instruments and missions. Current results from the UCAR COSMIC Data Analysis and Archive Center (CDAAC) suggest bending angle noise is near the 1.5e-6 radian level (depending on mission) and bending angle stability between different instruments is at the 3e-8 radian level.